



OCT 18 1917 ✓

GOLD MINING ✓

SYNOPSIS OF FILM

1. A Colorado Mining Town.
2. Mine Entrance Showing Electric Locomotive.
3. Drilling 1,000 feet under the Surface.
4. Placing the "Charge." Lighting the Fuse.
5. Loading Ore Car at a "Chute."
6. Ore on Way to the Mill or "Concentrator."
7. Ore Storage Bins.
8. Ore is Crushed to Size of an Egg.
9. Reducing Ore to a Powder or "Stamping."
10. Powder Washed from Under the "Stamps," Through a Screen and Across a Plate of Copper Coated with Quick-Silver. Particles of "Free Gold" Adhere to the Quick-Silver.
11. Heavy Metals Collect at End of Concentrating Table.
12. "Flotation Tank." Lighter Metals are Caught by a Thin Film of Oil Floating on the Surface.

13. Oily Scum Removed, Dried and Shipped to Smelter.
 14. Shoveling "Concentrates" at the Smelter.
 15. Roasting Concentrates to Remove Sulphur and Smelting the Ore.
 16. "Drawing off" the Molten Metal.
 17. Dumping the Molten Iron and Rock—the Slag.
 18. Pouring the Metal into Molds to Form Bars Called "Pigs."
 19. Removing Pigs from Molds.
 20. Loading Pigs for Shipment to Refinery.
 21. At the Refinery.
 22. Refined Gold is Cast into Bricks, and Sent to United States Mint.
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COINING GOLD (A Separate Film)

1. The United States Mint at Denver, Colorado.
2. Melting Furnaces at the Mint.
3. Pouring "Ingots."
4. Punching.
5. Rounding and Smoothing the Blank Coins.
6. Stamping the Blanks.
7. Inspecting.
8. Counting Coins.

6. Describe a stamp mill.
7. What is the appearance of the "concentrate?"
8. What becomes of the oily scum?
9. What happens at the smelter? At the refinery?

QUESTIONS ON THE FILM

Coining Gold

1. What is the first process at the Mint?
2. How is the molten gold handled?
3. In what form does the gold enter the punching machine? How does it leave?
4. What do you notice in particular about the stamping machine?
5. How are the coins counted?
6. How many mints are there in the United States? Where are they?

REFERENCES

- CURLEY. Gold mines of the World, London, 1899.
- E. B. WILSON. Hydraulic and Placer Mining, N. Y., 1907.
- DELMAR. History of the Precious Metals, London, 1880.
- N. B. KNOX, C. S. HALEY. The Mining of Alluvial Deposits, Min. Mag., Feb., 1915.
- Mint Processes of the United States, Treasury Department, Washington, D. C.
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Entire banks or hillsides are thus washed down into sluices of heavy construction. In the first length of sluice, a screen separates the large stones and boulders while the finer particles pass along to a second section, where strips of wood called "riffles" across the bottom hold the gold as it settles from the moving water. To catch the very fine particles of gold mercury is placed between these riffles. The mercury alloys with the gold, preventing it from washing away. The gold is later recovered from the alloy by distillation.

In recent years much progress has been made in the recovery of gold from these gravels which were formerly considered too poor to work. For this process great dredges have been constructed. The largest of these was launched in 1916 at Hammontown, California. It is essentially a flat-bottom steel boat 160 feet long, 60 feet wide, and 13 feet deep. An endless belt of 90 two-ton steel buckets, each of 16 cubic yards capacity, raises the gravel from the river bottom. A maximum depth of 86 feet can be reached. Electric motors of over 1,000 horse-power are required to operate the dredge which handles more than 16,000 cubic yards of material in a 24-hour day. Revolving screens and sluices on board, by a method similar to that of hydraulic mining, recover 55 to 60 cents worth of gold per cubic yard. Several dredges are in operation along the Yuba River, California.

The actual mining of gold in a vein is much as in other kinds of deep mining. At the Colorado mine shown in the film, a tunnel was driven into the mountainside until the vein was reached. Lateral tunnels were then pushed out, following the gold-bearing rocks.

At the "breast" of the tunnel a miner and his assistant are shown using a compressed air drill. From ten to twenty holes are made in order to break down sufficient rock to maintain the size of the tunnel. Dynamite is "tamped"

into the holes with fuses of different lengths so that separate charges will not "shoot" simultaneously. About three-fourths of the rock is waste, as the vein is usually but a few inches thick.

The ore is shoveled into chutes from which it is loaded into ore cars. An electric locomotive collects these cars into a train and hauls them out of the mine. The highest grade ore goes directly to the smelter, the poorer grades are taken to the "concentrator" where the precious metal is freed from the accompanying rock. The ore is first broken into pieces about the size of an egg and then crushed in the "stamps," which are machines in which rods weighing 1,500 pounds are made to pound or stamp upon the ore until it is reduced to a powder. The fine particles are washed from under the stamps over large plates of copper coated with mercury, which unites very readily with "free gold." The gold is recovered from the amalgam thus formed by distillation of the mercury.

The muddy stream is then made to flow over concentrating tables. These are grooved, inclined, and kept in vibration so that the heavier grains are carried to the lower end. The water and lighter materials are drawn off at the side of the table, and pumped into a "flotation" tank where it is kept in motion by stirring and by compressed air. A thin film of oil is floated over the surface to catch as much metal as possible. The scum is automatically removed, dried and shipped with the "concentrates" from the concentrating table and the highest grades of ore to the smelter. The value of these "concentrates" is between twenty-five and one hundred dollars per ton.

Very fine gold, which escapes the amalgamation process, may be extracted by the cyanide process which is used for the extraction of gold from the poorer grades of ores. A solution of potassium cyanide is one of the few solvents for gold, hence it is used extensively to dissolve out the metal

from the pulverized material. When the solution containing the gold is passed over zinc chips, the precious metal is deposited as a black powder. This powder is heated in a crucible and molten gold is obtained for casting into bars.

At the smelter, the ore is first roasted to drive off the sulphur which is usually present. It passes then to the furnaces where it is melted and metal is now obtained for the first time. The metal, a mixture of lead, silver and gold from the several furnaces, is drawn off into a ladle from which it is poured into a steel mixer, to be later run into molds. The slag or molten rock and iron is tapped off from the furnaces into slag-cars and hauled to a dump.

When the metal in the molds has become sufficiently cool, the bars, called "pigs," are stacked on small trucks, weighed and taken to freight cars for shipment to the refinery. Each of the bars weighs approximately 80 pounds.

Refining is the process of separating the several metals in the "pigs." An assay is first made to determine the exact composition of the bars. The particular process of separating or parting to be used is dependent upon the assayer's report. The two most common processes are the "wet" process in which the silver and baser metals are dissolved in a suitable acid without affecting the gold, and the electrolytic in which the separation is accomplished by an electric current. The gold thus obtained is 0.999 pure and is cast into 35-pound bricks for shipment to the mint or sent to manufacturing jewelers or others for industrial uses.

THE COINING OF GOLD

Gold coins are not pure gold, since that metal is too soft and easily worn away. Bullion which arrives at the mint is first assayed and then mixed with the purest copper in the proportion of 100 parts copper to 900 parts pure gold. These metals are melted in a crucible and thoroughly mixed. The metal is then cast into ingots which are reduced by passing between rollers until the proper dimensions are secured. The exact size of the strips thus formed varies with the particular coin to be made. The strips are fed through a machine which punches out "blanks" the size of the coin. These blanks are then carefully tested and those under weight are returned for remelting, while those which are too heavy are filed down. The accepted blanks are now rounded, milled on the edge and then fed to the stamping machines. The principal feature of these machines is the dies which are blocks of hardened steel upon which have been engraved the design to be impressed. One die has the design of the face and another of the reverse of the coin. The blanks are caught between them and squeezed with a force of 200 tons. The coins are now finished. A final inspection is given them after which they are dumped on a counting board which accepts a definite number and rejects the others. The coins are placed in bags, sealed and labeled.

QUESTIONS, TOPICS, SUGGESTIONS

1. What are the physical properties of gold? Why is it valued so highly?

GOLD MINING

GOLD is one of the precious metals—by many believed to be the first known to man. It has always been valued highly and during the Middle Ages was considered by alchemists to be the perfect metal, into which they sought to transform all other metals. In the pure state it is nearly as soft as lead, and is therefore alloyed with copper when used in coinage and jewelry. It is 19.31 times as heavy as water. It melts at about 1,800° F. It is unaffected by the air, moisture, common acids, or the gases usually occurring in the atmosphere.

The remarkable malleability of gold permits the production of sheets $1/300,000$ th of an inch in thickness. An ounce of gold forming a cube but little more than one-quarter of an inch thick may be hammered into a sheet having an area of over 150 square feet. The same amount may be drawn into an exceedingly fine wire having a length of nearly 15,000 feet.

Gold is widely distributed in nature, either in the native state or alloyed with small quantities of copper or iron. The source of the metal is still a matter of question to geologists. Its association with igneous rocks leads to the belief that it has been brought up from the depths of the earth. Deposits of gold are of three types—the river gravels, or “placers,” the high gravels, and the veins. The river gravels are found in the beds of streams, such as flow down the western slopes of the Sierras. The metal in them has been derived from the gold-bearing rocks of the higher levels, disintegrated, eroded and washed down in ages past. The high gravels are of a similar nature, lying in the beds of ancient and extinct rivers, long since buried by debris

and in places by lava formations. The veins, undoubtedly the source of the gold in the gravels, occupy old cracks or fissures, in slates and igneous rocks, where the metal is found scattered through a mass of crystalline quartz, either free or in combination with sulphur.

The gold of 1849 and the following years in California was taken from the "placer" or river gravels. More than three-fourths of Alaska's \$250,000,000 production since 1882 has been from placer workings. In the United States at present the proportion is about $3\frac{1}{2}$ to 1 in favor of deep mining, largely from the veins.

California leads in gold production in the United States. Colorado, Alaska and Nevada also are large contributors. The metal is mined to a less degree in seventeen other states. Nearly half of the world's annual production comes from Natal in South Africa. The United States, Australia, Russia and Mexico follow in the order named. The total production for 1915 was \$473,208,000 of which the United States furnished \$101,035,700. In 1916 the gold production of the United States was \$92,315,363.

In the gravel deposits, gold usually occurs in small grains 88% to 99.5% pure, distributed through the earth mixture, and its recovery is comparatively simple. In the earlier days, the miner placed gold-bearing gravel in a pan which was held in a brook, if handy, or in a sluice through which the water was brought from a distant stream. A shaking of the pan assisted the removal of the lighter material while the heavier gold settled to the bottom. No other process than repeated washing was needed to separate the gold completely. When the operation was conducted on a larger scale, a "cradle" replaced the pan. Later the hydraulic placer system was used in certain localities until it was forbidden by law.

In the hydraulic system a powerful stream of water is directed through a nozzle against the gold-bearing gravel.

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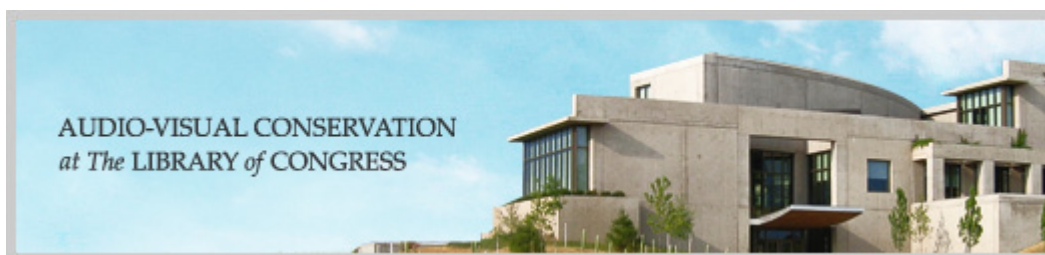
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